PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 13919/WO/01	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/IL2003/000436	International filing date *(day/month/year)* 26.05.2003	Priority date *(day/month/year)* 10.06.2002
International Patent Classification (IPC) or both national classification and IPC H04N13/00		
Applicant RAFAEL- ARMAMENT DEVELOPMENT AUTHORITY LTD. ET AL.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
06.01.2004	16.12.2005
Name and mailing address of the International preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Wahba, A Telephone No. +31 70 340-4597

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL2003/000436

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-19 as originally filed

Claims, Numbers

1-14 filed with telefax on 04.09.2005

Drawings, Sheets

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-14
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-14
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following document/s/:

D1: US-A-4 925 294 (GESHWIND DAVID M ET AL) 15 May 1990 (1990-05-15)

D2: US-B1-6 314 211 (KIM MAN-BAE ET AL) 6 November 2001 (2001-11-06)

D3: US-B1-6 215 516 (MA KELVIN ET AL) 10 April 2001 (2001-04-10)

D4: EP-A-0 735 512 (SANYO ELECTRIC CO) 2 October 1996 (1996-10-02)

D5: ZHANG X ET AL: "VISUAL VIDEO IMAGE GENERATION FROM VIDEO DATA USING PHASE CORRELATION TECHNIQUE" IEICE TRANSACTIONS ON INFORMATION AND SYSTEMS, INSTITUTE OF ELECTRONICS INFORMATION AND COMM. ENG. TOKYO, JP, vol. E83-D, no. 6, June 2000 (2000-06), pages 1266-1273, XP000976220 ISSN: 0916-8532

1 NOVELTY

1.1 The document D5 is regarded as being the closest prior art to the subject-matter of claims 1 and 12, and shows (the references in parentheses applying to this document):

a method for converting a sequence of monoscopic images to a sequence of stereoscopic images (D5: summary), comprising the following steps:

a) processing the original sequence of monoscopic images of a scene by use of a device that is capable of reading the individual images, digitizing the images if necessary, and storing the images in a memory unit;

b) selecting from said sequence a subset of images of interest (implicit in D5);

c) computing the collection of affine transformations (D5: col.4, l.13-15, "displacement") between the adjacent images in the subset;

d) selecting one image of the sequence of the subset of images of a scene that will be one member of the first stereo pair of the sequence (implicit in D5: col.8, l.35-37);

e) searching amongst tho remaining (D5: col.10, l.5-7) images in said subset for a second image , which can be transformed into a suitable stereo partner for said selected image, by determining the cascaded affine transformation to each of the successive images starting with the neighboring image to said selected image and applying the parallax criterion until said second image is found;

1.2 The subject-matter of claim 1 differs from this known method in that above method comprises furthermore the following steps:

f) calculating a planar transformation by using said selected image, said second image, and the cascaded affine transformation between them;

g) applying said planar transformation to said second image;

h) storing said selected image and the transformed second image in the memory unit; and

I) repeating steps c) through h) for the next and each of the remaining images of said selected subset.

1.3 The other cited documents (D1-D3) show methods for converting a sequence of monoscopic images to a sequence of stereoscopic image using a **single** image and applying a transformation to the single image to calculate a suitable stereo pair for above single image.

D1: col.3, l.10-11
D2: col.6, l.27-32
D3: col.3, l.23-25

Cited document D4 show a method for converting a sequence of monoscopic images to a sequence of stereoscopic image based on **depth information**.

D4: p.2, l.8

1.4 The subject-matter of claim 1 is therefore new (Article 33(2) PCT). Claim 12 relates to

a series of stereoscopic pairs of images produced by the method of claim 1 and the subject-matter of claim 12 is therefore also new.

2 INVENTIVE STEP

2.1 The problem to be solved by the present invention is to allow the camera to move irregularly (present application: p.10, l.6-21). Said problem is already known from D5 (D5: col.10, l.39-45). The problem of the present invention may, therefore, be regarded as providing an alternative solution.

2.2 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

In D5 a single image is shifted to left and right horizontally to add parallax (D5: col.10, l.51-54). Thus the same image shifted to left and right is used as a stereo pair. The present application solves above problem by applying a planar transformation to a **second** image (present application: cl.1, p.21, l.4) and using a first image which is different from the second image (present application: cl.1, p.20, l.13) and a transformed second image as a stereo pair.

Therefore the solution proposed in the present application is not disclosed or suggested in the prior art and cannot be derived therefrom.

3 DEPENDENT CLAIMS

3.1 Claims 2 to 11 are dependent on claim 1 and as such also meet/s the requirements of the PCT with respect to novelty and inventive step.

3.2 Claim 13 is dependent on claim 12 and as such also meet/s the requirements of the PCT with respect to novelty and inventive step.

3.3 It should be noted that **claim 14 does not comply with Article 6 PCT** because it

relates to a physical entity while it refers back to the method steps of claim 11. If claim 14 would be amended to meet Article 6 PCT it would also meet the requirements of the PCT with respect to novelty and inventive step.

Claims

1. A method for converting a sequence of monoscopic images to a sequence of stereoscopic images, comprising the following steps:

   a) processing the original sequence of monoscopic images of a scene by use of a device that is capable of reading the individual images, digitizing the images if necessary, and storing the images in a memory unit;

   b) selecting from said sequence a subset of images of interest;

   c) computing the collection of affine transformations between the adjacent images in the subset;

   d) selecting one image of the sequence of the subset of images of a scene that will be one member of the first stereo pair of the sequence;

   e) searching amongst the remaining images in said subset for a second image , which can be transformed into a suitable stereo partner for said selected image, by determining the cascaded affine transformation to each of the successive images starting with the neighboring image to said selected image and applying the parallax criterion until said second image is found;

f) calculating a planar transformation by using said selected image, said second image, and the cascaded affine transformation between them;

g) applying said planar transformation to said second image;

h) storing said selected image and the transformed second image in the memory unit; and

i) repeating steps c) through h) for the next and each of the remaining images of said selected subset.

2. A method according to claim 1, wherein the sequence of monoscopic images is chosen from amongst the frames of a monoscopic movie passively acquired using a single video camera or from a collection of images taken with a digital still camera.

3. A method according to claim 1, wherein the images comprising the sequence of monoscopic images are analog images that are scanned to produce digitized images.

4. A method according to claim 3, wherein the analog images can be images taken with a still or movie camera.

5. A method according to claim 1, wherein in steps c), e), and f) the affine transformation is replaced by any other transform that is

capable of estimating the relative position of the two cameras that produced the pair of images.

6. A method according to claim 1, wherein in step f) the planar transformation is replaced by any other transform that is capable of estimating the relative positions of the two cameras that produced the stereo pair of images.

7. A method according to claim 1, wherein the parallax criterion is expressed as a number of pixels of horizontal translational motion.

8. A method according to claim 1, wherein the parallax criterion is expressed in terms of high order elements of the transformation.

9. A method according to claim 1, wherein the searching in step (e) is carried out amongst the neighboring images on both sides of the selected image.

10. A method according to claim 1, wherein the searching in step (e) is limited to a maximum number of images on either side of the selected image.

11. A method according to claim 1, wherein the searching in step (e) is carried out using a non-sequential search, which may have steps of variable length, on one or both sides of the selected image and the cascaded affine or other transformation may be determined using only some of the successive images starting with the neighboring image to said selected image.

12. A series of stereoscopic pairs of images that are produced according to the method of claim 1 from a sequence of monoscopic images of a scene.

13. A stereoscopic movie produced from the series of stereoscopic pairs of images of claim12.

14. A stereoscopic movie according to claim 11 accompanied by a sound track, wherein said sound track is essentially identical to the sound track recorded with the sequence of monoscopic images from which said stereoscopic movie is produced.

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Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Wahba, A Telephone No. +31 70 340-4597

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International application No. PCT/IL2003/000436

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V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-14
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-14
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations

   see separate sheet

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Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

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1 NOVELTY

1.1 The document D5 is regarded as being the closest prior art to the subject-matter of claims 1 and 12, and shows (the references in parentheses applying to this document):

a method for converting a sequence of monoscopic images to a sequence of stereoscopic images (D5: summary), comprising the following steps:

a) processing the original sequence of monoscopic images of a scene by use of a device that is capable of reading the individual images, digitizing the images if necessary, and storing the images in a memory unit;

b) selecting from said sequence a subset of images of interest (implicit in D5);

c) computing the collection of affine transformations (D5: col.4, l.13-15, "displacement") between the adjacent images in the subset;

d) selecting one image of the sequence of the subset of images of a scene that will be one member of the first stereo pair of the sequence (implicit in D5: col.8, l.35-37);

e) searching amongst tho remaining (D5: col.10, l.5-7) images in said subset for a second image , which can be transformed into a suitable stereo partner for said selected image, by determining the cascaded affine transformation to each of the successive images starting with the neighboring image to said selected image and applying the parallax criterion until said second image is found;

1.2 The subject-matter of claim 1 differs from this known method in that above method comprises furthermore the following steps:

f) calculating a planar transformation by using said selected image, said second image, and the cascaded affine transformation between them;

g) applying said planar transformation to said second image;

h) storing said selected image and the transformed second image in the memory unit; and

I) repeating steps c) through h) for the next and each of the remaining images of said selected subset.

1.3 The other cited documents (D1-D3) show methods for converting a sequence of monoscopic images to a sequence of stereoscopic image using a **single** image and applying a transformation to the single image to calculate a suitable stereo pair for above single image.

D1: col.3, l.10-11
D2: col.6, l.27-32
D3: col.3, l.23-25

Cited document D4 show a method for converting a sequence of monoscopic images to a sequence of stereoscopic image based on **depth information**.

D4: p.2, l.8

1.4 The subject-matter of claim 1 is therefore new (Article 33(2) PCT). Claim 12 relates to

a series of stereoscopic pairs of images produced by the method of claim 1 and the subject-matter of claim 12 is therefore also new.

2 INVENTIVE STEP

2.1 The problem to be solved by the present invention is to allow the camera to move irregularly (present application: p.10, l.6-21). Said problem is already known from D5 (D5: col.10, l.39-45). The problem of the present invention may, therefore, be regarded as providing an alternative solution.

2.2 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

In D5 a single image is shifted to left and right horizontally to add parallax (D5: col.10, l.51-54). Thus the same image shifted to left and right is used as a stereo pair. The present application solves above problem by applying a planar transformation to a **second** image (present application: cl.1, p.21, l.4) and using a first image which is different from the second image (present application: cl.1, p.20, l.13) and a transformed second image as a stereo pair.

Therefore the solution proposed in the present application is not disclosed or suggested in the prior art and cannot be derived therefrom.

3 DEPENDENT CLAIMS

3.1 Claims 2 to 11 are dependent on claim 1 and as such also meet/s the requirements of the PCT with respect to novelty and inventive step.

3.2 Claim 13 is dependent on claim 12 and as such also meet/s the requirements of the PCT with respect to novelty and inventive step.

3.3 It should be noted that **claim 14 does not comply with Article 6 PCT** because it

relates to a physical entity while it refers back to the method steps of claim 11. If claim 14 would be amended to meet Article 6 PCT it would also meet the requirements of the PCT with respect to novelty and inventive step.

Claims

1. A method for converting a sequence of monoscopic images to a sequence of stereoscopic images, comprising the following steps:

   a) processing the original sequence of monoscopic images of a scene by use of a device that is capable of reading the individual images, digitizing the images if necessary, and storing the images in a memory unit;

   b) selecting from said sequence a subset of images of interest;

   c) computing the collection of affine transformations between the adjacent images in the subset;

   d) selecting one image of the sequence of the subset of images of a scene that will be one member of the first stereo pair of the sequence;

   e) searching amongst the remaining images in said subset for a second image , which can be transformed into a suitable stereo partner for said selected image, by determining the cascaded affine transformation to each of the successive images starting with the neighboring image to said selected image and applying the parallax criterion until said second image is found;

f) calculating a planar transformation by using said selected image, said second image, and the cascaded affine transformation between them;

g) applying said planar transformation to said second image;

h) storing said selected image and the transformed second image in the memory unit; and

i) repeating steps c) through h) for the next and each of the remaining images of said selected subset.

2. A method according to claim 1, wherein the sequence of monoscopic images is chosen from amongst the frames of a monoscopic movie passively acquired using a single video camera or from a collection of images taken with a digital still camera.

3. A method according to claim 1, wherein the images comprising the sequence of monoscopic images are analog images that are scanned to produce digitized images.

4. A method according to claim 3, wherein the analog images can be images taken with a still or movie camera.

5. A method according to claim 1, wherein in steps c), e), and f) the affine transformation is replaced by any other transform that is

capable of estimating the relative position of the two cameras that produced the pair of images.

6. A method according to claim 1, wherein in step f) the planar transformation is replaced by any other transform that is capable of estimating the relative positions of the two cameras that produced the stereo pair of images.

7. A method according to claim 1, wherein the parallax criterion is expressed as a number of pixels of horizontal translational motion.

8. A method according to claim 1, wherein the parallax criterion is expressed in terms of high order elements of the transformation.

9. A method according to claim 1, wherein the searching in step (e) is carried out amongst the neighboring images on both sides of the selected image.

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12. A series of stereoscopic pairs of images that are produced according to the method of claim 1 from a sequence of monoscopic images of a scene.

13. A stereoscopic movie produced from the series of stereoscopic pairs of images of claim12.

14. A stereoscopic movie according to claim 11 accompanied by a sound track, wherein said sound track is essentially identical to the sound track recorded with the sequence of monoscopic images from which said stereoscopic movie is produced.

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Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Wahba, A Telephone No. +31 70 340-4597

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